Title:	Advances in Modular Gravitation Reference Sensor (MGRS) Technologies
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Abstract

Modular Gravitational Reference Sensor (MGRS) is designed for lower cost, high reliability precision space missions for fundamental physics and astronomical imaging. MGRS reduces the instrument complexity by separating the internal and external measurements. Further, MGRS uses multiple optical sensors to achieve redundancy and reliabilities. We have continued to make significant progresses in MGRS technologies. We have devised a two-layer optical sensing scheme, in which science measurement is accomplished via picometer precision interferometric sensors, and the drag-free control signal is obtained via large dynamic range shadow sensors. We have demonstrated the optical shadow sensing with nanometer precision. We are working towards demonstrating rf modulated, low power inteferometric sensors with picometer precision. We have improved our sphere mass center measurement to a precision better than 300 nm. We have tested algorithms for determining the center of mass position with redundant multiple optical sensors data from MGRS. We have improved the sensitivity of our grating angular sensor to 0.1 nanoradian. Further we have demonstrated a UV LED based charge management system, and have been testing the GaN based UV LED with a 255 nm wavelength for more than 11,000 hours. We have also started a parallel lifetime test for operating UV LED in spacelike vacuum environment. With a combined passive/active thermal control approach, we have achieved a thermal design with temperature stability 0.1 microkelvin. These technologies are important to MGRS and can be applied to other high space interferometer missions beyond LISA.